A Comparison of Relative Ear Length Between Two Neighboring Populations of *Peromyscus maniculatus*

A Senior Project

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Bachelor of Science

by

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Abstract:

This study attempts to determine if a significant difference in relative ear length exists between two neighboring populations of *Peromyscus maniculatus* on the central coast of California. Data was collected from individuals trapped at two plots in the Guadalupe-Nipomo Dunes National Wildlife Refuge and two plots near Black Lake, under the supervision of Francis X. Villablanca, Ph. D. of California Polytechnic State University, San Luis Obispo. A total of 98 individuals were captured over the course of three nights of trapping. A regression analysis was performed comparing the ear lengths of each population relative to body size. The analysis of the data showed that there was no significant difference in ear length between the two populations.

Introduction:

Deer mice (*Peromyscus maniculatus*) are one of the most abundant and widespread mammals of North America (Hall, 1981). Their range extends from the northern regions of Alaska and Canada south into central Mexico. Along with a wide geographic distribution, *P. maniculatus* are found in a variety of habitats. However, they are most commonly associated with prairies, brushy areas, and woodlands (King, 1968). With such a large range, numerous geographical variations would be expected to occur between populations, and over 60 different subspecies of *P. maniculatus* have been described thus far (Hanney, 1975).

In San Luis Obispo County, two subspecies of *P. maniculatus* occur. The first, *P. m. gambelii*, occurs in more coastal areas whereas the other, *P. m. sonoriensis*, occurs further inland (Hall, 1981). However, the boundary between these two subspecies is not clearly known in San Luis Obispo County (Figure 1).

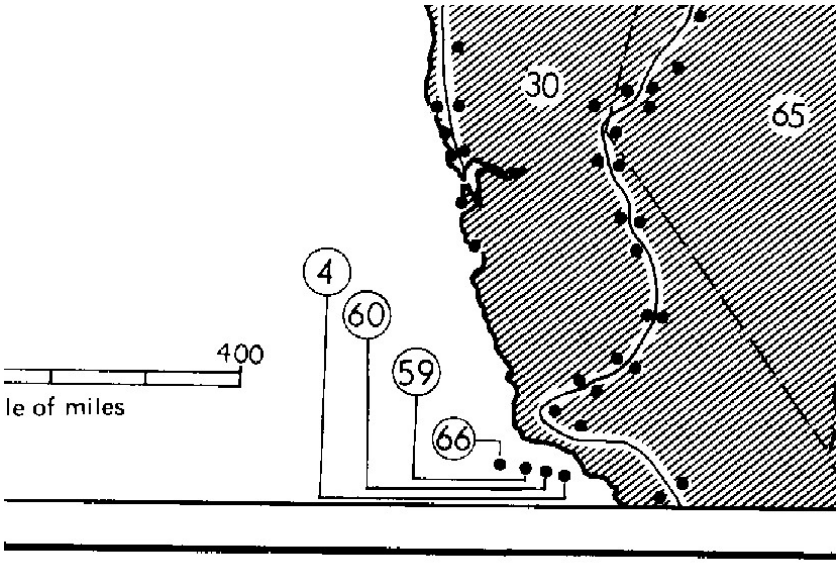

Figure 1: Range of *P. m. gambelii* (30) and *P. m. sonoriensis* (65) in California.

During the course of a study of Lompoc Kangaroo Rats (*Dipodomys heermani arenae*) by Dr. Francis X. Villablanca, Ph. D., several *P. maniculatus* individuals were captured at the Guadalupe-Nipomo Dunes National Wildlife Refuge (GNDNWR) that seemed to have disproportionately large ears compared to individuals captured at neighboring sites. For many rodent species and subspecies, ear length can be a good diagnostic for identification, and previous studies on *P. maniculatus* have shown that ear length can be a good diagnostic characteristic when trying to distinguish subspecies (Dice, 1942). If it was determined that the GNDNWR population had relatively larger ears than the Black Lake population, it could suggest that these two populations were composed of different subspecies, allowing for a better understanding of their respective distributions within the county.

The following report outlines the methods and results of a study performed to determine if the population of *P. maniculatus* at the National Wildlife Refuge did in fact have larger ears relative to body size that the *P. maniculatus* population of the neighboring site at Black Lake.

Based on preliminary observations, the hypothesis was that the individuals of the Guadalupe-Nipomo Dunes National Wildlife Refuge population would have significantly larger ears relative to body size than individuals from the Black Lake/Callender Road population.

Methods:

Data was collected from several sites on the central coast of California. The first site was located at the Guadalupe-Nipomo Dunes National Wildlife Refuge (GNDNWR), several miles north-west of Guadalupe, CA (Figure 2). The second site was located approximately 3.25 miles away in the vicinity of Black Lake and Callender Rd (Figure 2). Two plots were established at each site. Each plot consisted of three rows of seven stations, each station with two traps, for a total of 42 traps per plot and 168 traps total. The data was collected in conjunction with an ongoing, long-term research project by Dr. Francis X. Villablanca, Ph. D.

Individuals were trapped using Sherman extra-long traps baited with rolled oats. Traps were covered with sand to insulate against the cold nights. Two traps were placed at each station within two meters of the stake marking the station. Traps were placed at each station for three consecutive nights starting on January 3, 2013, and ending on January 5, 2013. The traps were set near dusk to prevent any accidental captures of diurnal animals, especially birds. The traps were checked near dawn the next morning to help minimize the time the animals spent in the traps in an effort to minimize trap mortality.

Figure 2: Location of the sampling sites. Two plots were sampled at each site. The sandy coastline to the west is the Oceano Dunes State Vehicular Recreation Area and the Guadalupe-Nipomo Dunes National Wildlife Refuge. The Santa Maria River runs along the bottom of the image.

When a mammal was caught, it was emptied into a bag, identified, and sexed. Further data was collected on any Kangaroo Rats caught for Dr. Villablanca's research. Any *Peromyscus maniculatus* that were captured had their ear, tail, and hind foot lengths taken. They were then marked on the foot using a permanent marker so that recaptures could be recognized. Data was collected only from newly capture individuals. The majority of the data (86 individuals) was collected by a single individual in an attempt to minimize measurement variation. Once the data was collected, the individual was released at the capture site. Over the course of the trapping session, 98 *P. maniculatus* were captured.

Results:

Once the data was compiled into Excel, a regression was created comparing tail and hind foot lengths (Figure 3). This was done to determine which parameter was a better indicator of overall size. Since the relationship nearly had a slope of zero, indicating a growth plateau for hind foot length had been reached, it was decided that tail length would be used as an indicator of overall body size. A histogram of the frequency of the ear lengths for each population was also compiled to compare for distribution differences (Figure 4).

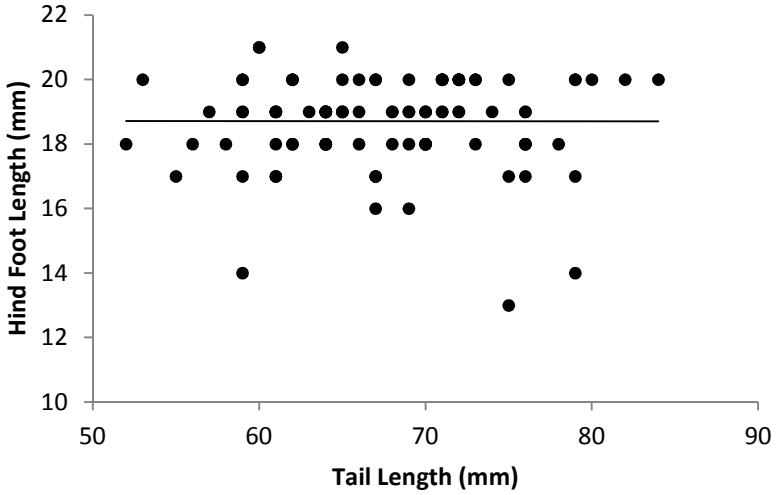

Figure 3: Graph showing the relationship between tail length and hind foot length for the combined data set (both sites, all four plots). R = -0.00197, P > 0.40. (n=97).

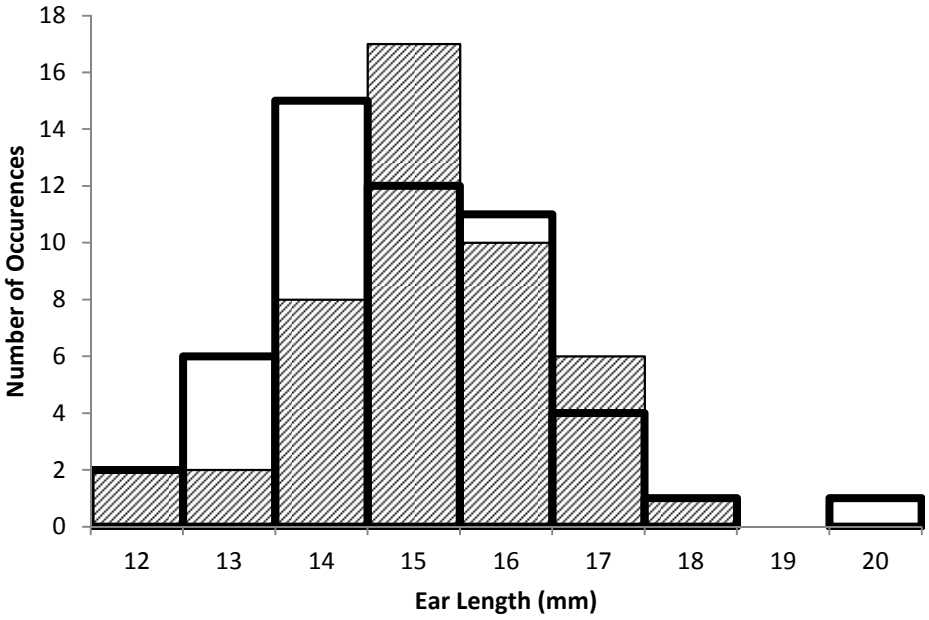

Figure 4: Histogram of the distribution of ear lengths at both sites. Black Lake/Callender in white, GNDNWR in hashed (n=51 and 46, respectively).

Once tail length was chosen as an indicator of overall size, a regression was created for each population with tail length on the X-axis and ear length on the Y-axis (Figure 5). The correlation coefficient was then calculated for each population. Since the two populations had such a similar distribution and a large amount of overlap, it was determined that there was no significant difference between the two, and the data was combined in an attempt to more clearly define the relationship between ear and tail lengths (Figure 6).

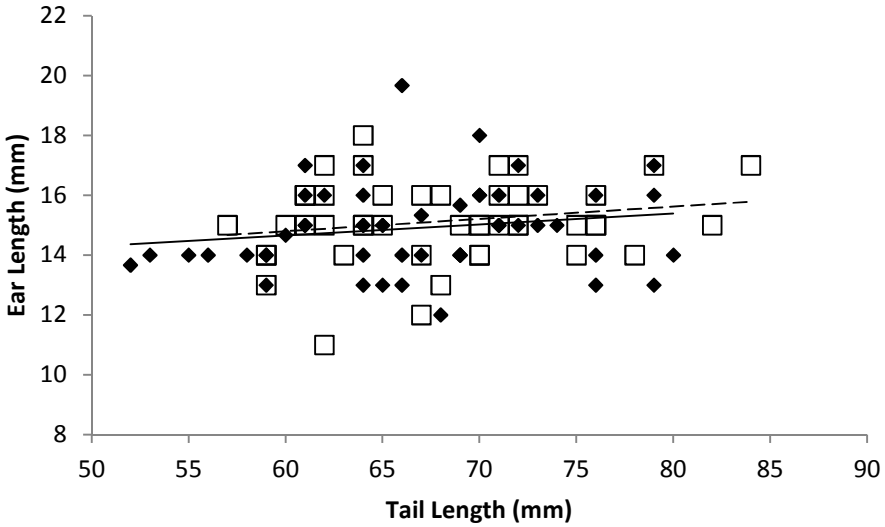

Figure 5: Ear length vs. tail length for the GNDNWR plots, squares and dashed line, and the Black Lake/Callender plots, diamonds and solid line (n=46 and 51, respectively). GNDNWR: R = 0.1967; 0.20 > P > 0.10. Black Lake/Callender: R = 0.0176; P > 0.40.

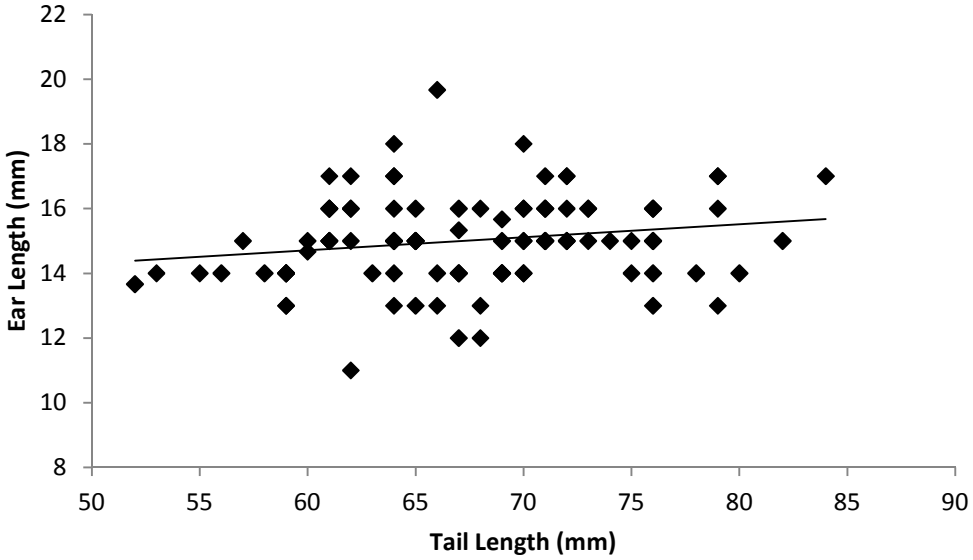

Figure 6: Ear length vs. tail length for the combined data set (n=97). R = 0.192, 0.06 > P > 0.05.

The initial comparison of tail and hind foot lengths did not reveal a significant relationship, with an R value of -0.00197 and a P value greater than 0.40. The regression for the Black Lake site showed no significant relationship between tail length and ear length, with an R value of 0.0176 and P value greater than 0.40 (Table 1). The regression for the GNDNWR site also showed no significant relationship between tail length and ear length, with an R value of 0.1967 and a P value between 0.10 and 0.20 (Table 2). There was no significant difference between these two populations, meaning that the hypothesis predicting a difference in relative ear lengths cannot be supported. The regression for the combined data set was on the edge of being potentially significant, with an R value of 0.192 and a P value between 0.05 and 0.06. Therefore, there is most likely a small, though probably significant, relationship between ear length and tail length for these two populations.

	Tail	Ear	Z_{tail}	Z_{ear}	Z_t*Z_e
Sum	--	--	0	0	8.74122
Mean	66.7451	14.90196	--	--	--
SD	6.855197	1.447287	--	--	--

Table 1: Summary statistics for the Black Lake/Callender site (R = 0.0176; P > 0.40; n=51).

	Tail	Ear	Z_{tail}	Z_{ear}	Z_t*Z_e
Sum	--	--	0	0	8.894369
Mean	68.15217	15.13043	--	--	--
SD	6.538662	1.359881	--	--	--

Table 2: Summary statistics for the GNDNWR site (R = 0.1967; 0.20 > P > 0.10; n=46).

	Tail	Ear	Z_{tail}	Z_{ear}	$Z_t * Z_e$
Sum	--	--	0	0	18.42885
Average	67.41237	15.01031	--	--	--
SD	6.709372	1.403908	--	--	--

Table 3: Summary statistics for combined data ($R = 0.192$; $0.06 > P > 0.05$; $n=97$)

Discussion:

The results of this study indicate that there is no significant difference in relative ear length between the two populations, causing the ear length hypothesis to be rejected and failing to reject the null hypothesis. The two populations had very similar distributions when plotting ear vs. tail length, with a large amount of overlap occurring. Since there was no difference between the populations, it was determined that it was not possible to distinguish whether or not these two populations were composed of different subspecies of *P. maniculatus* using relative ear length.

One interesting result was the relationship between tail and hind foot lengths. The fact that the R value was so small indicates that there may be a growth plateau for hind foot length. Previous studies have shown that certain body parts of juvenile *P. maniculatus* develop at a faster rate and reach adult size earlier than other parts. This has been shown in several subspecies of *P. maniculatus* to be true for the hind feet, which grow rapidly in the first weeks after birth and quickly reach maximum, adult size (Dice, 1942).

This concept of different, relative growth rates, or allometry, could also explain why the relationship between overall size, indicated by tail length, and ear length was so loose. If both the ears and the tail grew at a similar rate, it would be expected that as an individual *P. maniculatus* grew in size, its ears would grow at a rate relative to the increasing body size. However, it is also possible that the ears, like the hind feet, grow at a faster rate and reach maximum length sooner

than the tail does. It has been shown that for at least seven *P. maniculatus* subspecies, the tail does grow at a fairly steady rate while the ears tend to grow faster at a younger age and then begin to slow markedly with age (Dice, 1942).

Works Cited:

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King, J. A. 1968. Biology of Peromyscus (Rodentia). First Edition. The American Society of Mammalogists, Stillwater, Oklahoma.

Hanney, Peter W. Rodents: Their Lives and Habits. New York: Taplinger Publishing Company, 1975.

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Appendix 1:

Site: BL + Callender		Date: 1/3/2013 - 1/6/2013	
Sex	Ear Length (mm)	Tail Length (mm)	HF Length (mm)
F	14	66	20
M	15	60	21
F	13	59	14
M	16	69	20
F	16	61	17
F	20	66	19
M	15	67	20

F	14	52	18
M	16	70	19
M	14	69	19
M	17	72	20
F	14	64	19
M	16	76	19
M	14	69	19
F	15	73	20
M	16	71	19
F	17	64	18
M	15	65	20
F	14	80	20
F	14	59	20
M	15	61	19
F	14	58	18
M	14	76	17
**M	6	75	13
F	16	62	20
M	17	61	19
F	15	65	19
M	16	70	18
F	13	64	19
M	14	56	18
M	14	69	16
F	15	64	19
F	13	79	14
M	14	67	17
F	15	64	18
F	16	79	17
F	15	71	20
F	16	64	18
F	15	72	19
F	14	53	20

F	13	76	18
F	14	55	17
F	15	71	19
M	18	70	19
M	13	65	19
M	12	68	18
M	16	73	18
M	15	74	19
M	13	66	18
M	15	61	19
F	14	59	19
M	17	79	20

Table 4: Data collected from the four plots at the Black Lake/Callender Rd. Site (n=52). Individual marked with ** was considered an outlier and thrown out of the data set for the analyses.

Site: GNDNWR 1 & 2		Date: 1/3/2013 - 1/6/2013	
Sex	Ear Length (mm)	Tail Length (mm)	HF Length (mm)
M	15	70	19
F	16	67	20
F	15	62	20
M	16	71	20
F	16	68	19
M	17	64	19
M	14	59	19
F	17	84	20
M	14	67	17

F	16	76	18
F	14	63	19
F	15	64	19
F	15	76	18
F	15	65	19
F	16	65	21
F	12	67	16
M	17	71	20
F	16	61	19
M	15	57	19
M	14	70	18
M	16	73	20
M	17	72	20
F	14	59	20
M	15	75	17
M	18	64	19
F	14	70	18
M	15	71	20
M	17	79	20
F	15	82	20
M	15	60	21
F	11	62	18
M	17	62	20
F	14	78	18
M	16	72	20
F	15	61	18
M	14	75	20
M	15	64	18
M	13	68	19
F	16	61	17
M	15	76	19
M	15	72	19
M	15	70	18

M	15	69	18
F	16	62	18
M	15	72	20
F	13	59	17

Table 5: Data collected from the four plots at the GNDNWR Site (n=46).